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Published in:
Human-Animal Interaction Bulletin

E-pub ahead of print: 20/08/2019

Document Version
Peer reviewed version

[Link to publication on the UWS Academic Portal](#)

Citation for published version (APA):

Hawkins, R. D., & Williams, J. M. (2019). The development and pilot evaluation of a 'serious game' to promote positive child-animal interactions. *Human-Animal Interaction Bulletin*, 8(2). https://www.apa-hai.org/human-animal-interaction/pre-publication_articles/the-development-and-pilot-evaluation-of-a-serious-game-to-promote-positive-child-animal-interactions-2/

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The Development and Pilot Evaluation of a ‘Serious Game’ to Promote Positive Child-Animal Interactions

Running head: SERIOUS GAME TO PROMOTE POSITIVE CHILD-ANIMAL INTERACTIONS

Abstract

Animal welfare education aims to nurture compassion, respect and kindness to animals but there remains a need for more rigorous evaluations of such programmes to assess the most effective approaches. Incorporating technology into animal welfare education is a relatively novel field. This study examines the process of designing, developing, and evaluating the effectiveness of a new theoretically-driven educational computer game intervention. Pet Welfare was designed for children aged 7-12 years, to promote positive child-animal interactions. A pre-test, post-test, test-control, quasi-experimental design was used using a self-report questionnaire that children completed within class. Participants included 184 primary-school children from schools in Scotland, UK. The results indicated a positive impact on knowledge about animal welfare needs, knowledge about appropriate and safe behaviour towards pets and beliefs about pet minds. Children were also less accepting of cruelty to pets. . There was no impact on self-reported compassion. This study presents the first evaluation of a digital animal welfare ‘serious game’ for children, demonstrating the benefits of incorporating technology and game-based learning into animal cruelty prevention. The results of this study will inform future education directions for those wishing to promote positive and safe relationships between children and animals.

Key words: Animal Cruelty; Animal Welfare; Children; Education; Technology; Serious games

Introduction

School-based animal welfare education aims to nurture compassion, respect and kindness to animals, can facilitate empathy, humane attitudes, prosocial skills and behaviour, and can play a key role in violence prevention (Arbour, Signal & Taylor, 2009; Ascione & Weber, 1996; Faver, 2010; Nicoll, Trifone & Samuels, 2008). Such programmes can be built into existing curricula, follow school pedagogy and therefore meet educational standards by building on specific subjects (‘curriculum-blended’; Ascione, 1997). Animal welfare education programmes can also be built upon the framework of curriculum for excellence (Hawkins, Williams & Scottish SPCA, 2017a). Even though many programmes that involve direct child-animal interactions have proven to be successful (e.g.

Nicoll, Samuels & Trifone, 2008; Tardif-Williams & Bosacki, 2015), direct contact is neither always possible nor necessary (e.g. Ascione, 1993; Hawkins, Williams & Scottish SPCA, 2017a). Scientific evaluations of such programmes are lacking, and evaluation studies that do exist, lack methodological rigour with many not including control groups. This paves the way for new collaborations between researchers, psychologists and animal welfare organisations to develop and evaluate the effectiveness of such programmes and assess the best practices in promoting positive human-animal interactions.

There is a lack of research into the development and evaluation of interventions which aim to prevent animal cruelty and to promote positive child-animal interactions. Those interventions that do exist, have focused on intervention once a child has been cruel to an animal, rather than on prevention. Most research on childhood animal cruelty rarely considers cruelty within the general population, instead focusing on narrow clinical or other special populations (Ascione, 1993; Felthous & Kellert, 1987; Hawkins, Hawkins & Williams, 2017; Longobardi & Badenes-Ribera, 2018), but ideally, prevention programmes should be universal. We know from previous research (Hawkins, 2018; Hawkins, Hawkins & Williams, 2017) that most cruelty towards animals in childhood is accidental, and that education is the key to preventing unmotivated animal cruelty and promoting positive and safe child-animal interactions (Hawkins, Williams & Scottish SPCA, 2017a). We also know that dogs, cats and rabbits are not only the most common pets in the UK, but also the most common targets for pet cruelty in childhood (Scottish SPCA, 2017; PDSA, 2011). The present study examines the effectiveness of a new theoretically-driven digital educational intervention for children in the general population, focusing on dogs, cats and rabbits. Pet Welfare was designed to enhance compassion, understanding of animal sentience, animal welfare needs, appropriate and safe behaviour towards animals, and prevent animal cruelty from an early age.

As mentioned, childhood animal cruelty is often unintentional, and may have cognitive roots, resulting from misinterpretation of animal behaviour and welfare needs, as well as a lack of knowledge about appropriate and safe behaviour towards animals, and lack of ability to recognise emotional signals in pets (Hawkins & Williams, 2016; Lakestani, Donaldson, Verga & Waran, 2006; Meints & De Keuster, 2009). Reducing acceptance of animal cruelty (indicative of cruelty behaviour) through education is a key goal, which could be achieved through the inclusion of emotional material aimed to increase beliefs about animal minds, how to accurately identify emotional signals (Hawkins & Williams 2016; Lakestani, Donaldson & Waran, 2014; Meints, Racca & Hickey, 2010), and through examples of animal cruelty and neglect (Hawkins, Williams & Scottish SPCA, 2017a). Educational materials need to be child-friendly and ethically appropriate, without distressing images. This can be tackled through focusing on accidental and intentional animal cruelty using common everyday scenarios and behaviours (e.g. “Should you pull a cat’s whiskers?”).

68 Considering unmotivated animal cruelty and neglect, children also seem to lack detailed animal
69 welfare knowledge (Jamieson et al., 2012; Muldoon et al., 2009; Wells & Hepper, 1995), leading to
70 inadequate animal care (Batson, 2008) and animal welfare issues such as irresponsible pet ownership
71 (Buckland et al., 2014). Research shows that even adult pet owners lack knowledge about pet welfare
72 and social needs, especially concerning rabbits (Edgar & Mullan, 2011). Teaching children about the
73 complex welfare needs of animals, their natural behaviours and social needs, is important to promote
74 positive pet-owner relationships and prevent accidental cruelty and neglect (D'ovidio, Pierantoni,
75 Noviello & Pirrone, 2016). Moreover, evidence-based educational interventions that target these
76 cognitive factors may have the potential for promoting responsible pet care, optimal pet welfare, and
77 for the prevention of cruelty and neglect (Buckland et al., 2014; Tardif-Williams & Bosacki, 2015).

78 Computer games for educational purposes (i.e. 'game-based learning' or 'serious games'), have been
79 found to be more effective at increasing learning and retention, and cognitive outcomes than
80 traditional teaching methods (Vogel et al., 2006; Wouters, Van Nimwegen, Van Oostendorp & Van
81 Der Spek, 2013). Computer games can be built upon the science or 'pillars' of learning, ensuring high
82 quality education, and can target both cognitive and affective aspects of learning and have been
83 shown to promote helping behaviour and reduce aggressive cognitions (Ewoldsen et al., 2012;
84 Schmierbach, 2010; Chi, 2009; Hirsh-Pasek et al., 2015; Alfieri et al., 2011; Darling-Hammond,
85 2008; Fisher et al., 2011; James & Swain, 2011). Moreover, technology can be utilised to create
86 emotionally engaging experiences for children which fosters interest in animals, promotes a sense of
87 emotional connection to another species, and subsequently elicits cognitive and affective empathy for
88 animals (Webber et al., 2017). The use of photos can stimulate positive responses towards animals
89 (Myers, Saunders & Bexell, 2009). There is therefore exciting potential for new educational computer
90 games to be developed and evaluated which aim to promote positive child-animal interactions.

92 **The Present Study**

93 The aim of this study was to evaluate the effectiveness of a new 'serious game' named Pet Welfare.
94 This study aimed to answer the following research question: Does the Pet Welfare game intervention
95 have a significant impact on children's beliefs about pet minds, knowledge about animal welfare
96 needs, knowledge about appropriate and safe behaviour towards pets, compassion towards animals
97 and acceptance of cruelty to pets? It was hypothesised that there would be a significant pre- to post-
98 test change for all target outcomes for the intervention group but not the control group.

100 **Method**

Development of Pet Welfare

Pet Welfare was developed using Articulate Storyline 2 (www.articulate.com), an e-learning tool that allows interactive educational material to be developed for online or offline use. A series of interactive levels were developed for the three types of pets (dogs, cats and rabbits) incorporating text, images and sound. Three levels were developed per animal to provide variety and different interactivity. Children received feedback throughout the game and viewed their scores. All images were either provided by the Scottish SPCA or purchased from photo stock websites. Once developed, the game was downloaded and played offline through the Articulate Storyline Mobile App player on iPads in class (also available on other devices).

Based on a literature review, key target outcomes were decided before the development of the game, feeding into decisions made regarding content, and therefore were the focus of the evaluation procedure. A logic model based on the Evidence Based Practice Unit (EBPU) Logic Model (Wolpert et al., 2016) was created to inform the development of the game (Figure 1). Based on the logic model, an evaluation questionnaire was developed. This included measures to test the key target outcomes of the game (knowledge, beliefs about pet minds, compassion and acceptance of cruelty to pets). All content and feedback were based on current scientific research into animal sentience, behaviour and welfare and confirmed by animal behaviour experts to ensure accuracy and to avoid misinformation. Images were also sent to three animal behaviour experts for validation during the development phase to ensure accuracy of the emotions displayed. All three behaviour experts had expertise in identifying and recognising behaviour stills and agreed accuracy of all images.

[Figure 1 about here]

Level 1: Sentience and Belief in Animals Minds

Level 1 targeted children's beliefs about pet minds. The aim of this level was to teach children that pet animals are sentient and to facilitate their beliefs about pet minds using the most up-to-date research on animal emotion and cognition. The questions focused on the items from the Children's Beliefs about Animal Minds measure (Hawkins & Williams, 2016), happiness, sadness, fear, pain and intelligence. In this level, an image was presented on the screen (e.g., a scared dog) with the question "how is this dog/cat/rabbit feeling?". Children had to choose a correct answer from four options (happy/sad/scared/in pain). One image per emotion (happy/sad/scared) was provided per animal. Where no suitable image was available, children were shown a neutral image of an animal and asked "can dogs/cats/rabbits feel pain?" and "are dogs/cats/rabbits clever?" and subjects had to click yes or no on the screen. Feedback was provided about information on animal behaviour relating to those

emotions (e.g. “This dog is frightened. A frightened dog might crouch down or whimper”). The feedback was made short, simple and child-friendly. For correct answers, children were congratulated and provided with feedback, for incorrect answers, “oops that was incorrect” was displayed and children were given another chance. All emotion images had a plain white background to prevent children from looking for visual cues in the background of images.

Level 2: Knowledge of Animal Welfare Needs

The goal of level 2 was to tackle potential inaccurate knowledge and promote new knowledge around the welfare needs of animals and highlight the five freedoms. This level focused on what pet animals need to be ‘happy and healthy’ through a ‘drag and drop’ game. For each animal, children had options of care items (e.g. water) and distractors (e.g. chocolate) to move on the screen and were asked “what does a dog/cat/rabbit need to be happy and healthy?”. Correct items had to be moved onto a target animal icon and incorrect items onto a bin icon. Incorrect answers ‘bounced back’ and so children had to keep trying until all items were on the correct location. Once finished, feedback was provided about the five freedoms for each animal to reinforce learning and provide context to the items.

Level 3: Appropriate Behaviour

Level 3 focused on children’s interactions with pets, which is important for preventing accidental animal cruelty (Buckland et al., 2014; Shen et al., 2016). This level involved a quiz where children had to respond to questions by pressing ‘yes’ or ‘no’. The questions related to animal welfare knowledge (e.g. “Should you give a dog chocolate?”), accidental animal cruelty (e.g. “Should you hold a rabbit upside down like a baby?”), motivated animal cruelty (e.g. “Should you kick a cat?”), animal neglect (e.g. “Should you leave a cat alone for a few days without feeding it?”) and safe behaviour towards animals (e.g. “Should you approach a dog you don’t know?”), two questions per theme and ten questions per animal. Feedback reinforcing key messages was provided after each question (e.g. “Rabbits do not like this, they become stressed. It slows their heartbeat and puts them in a trance like state which can be harmful”).

Evaluation Method

Participants

Participants included 184 primary school children, 92 test and 92 control (53% boys, 47% girls) from three schools in West Lothian, Scotland, UK. Randomisation was not possible for this study and so a quasi-experimental design was used. Two schools made up the test group and one school made up the control group. Children were aged between 7-years and 12-years ($M=10$, $SD=1$) and from two age classes, 7-9-years (42%) and 10-12-years (58%). The control group was from a separate school and age-matched to the test group. Most children had pets (63%). The types of pets owned were: dogs (40%), cats (20%), rabbits (1%), other small mammals (8%), horse/donkey/pony (2%), birds (4%), fish (11%), and reptiles/amphibians (4%).

Design

A quasi-experimental, mixed factorial design was used to evaluate the intervention. One variable was phase of testing (time), a repeated-measures variable with two conditions: pre-tests (day before intervention) and post-tests (two days after intervention). The between-subjects variable was the intervention condition (game intervention vs. control).

Procedure

The ethical guidelines of the British Psychological Society, specifically relating to research with children, were adopted for this research, and ethical consent was granted from an internal review board at the host university. Permission was granted from the local authority before schools were contacted via email and telephone. Head teachers and class teachers were provided with information regarding the study and participation was at their discretion. Parents/guardians were provided with a covering letter and project information sheet at least a week ahead of the study. Opt-out forms were provided to complete and return to the school if a parent/guardian wished not to give their consent for their child to participate in the research project. Only one parent opted their child out from the study. Child consent was also obtained with child-friendly consent forms.

The pre-test, intervention, and post-test conditions were conducted over three school days. Children completed the pre-test questionnaire on the first day (Monday), played the game intervention on the second day (Tuesday) and then completed the post-test questionnaire two days later (Thursday). The control group followed a similar pattern whereby they completed the pre-test questionnaire on the first day (Monday), went about usual class activities on the second day (Tuesday), and completed the post-test questionnaire two days later (Thursday). The control group were able to play the game immediately following the completion of the post-test questionnaire. On the intervention day, children took turns individually playing the game at their school desk. The game took each child approximately 15 minutes to complete.

Pre- and Post-test Questionnaire

A self-report questionnaire was developed as the evaluation tool and administered during class time. The questionnaire comprised of a range of validated child-animal measures described below, each checked for reliability using Cronbachs Alpha. The questionnaire took each child approximately 15 minutes to complete and they could ask the researcher or their teacher for help if needed. The researcher and teachers could only help the children read or understand a question and did not provide the child with any answers. Demographic questions including gender, age and pet ownership (yes/no) were incorporated. Other measures included: beliefs about pet minds, knowledge about the five freedoms, knowledge about appropriate and safe behaviour, compassion, and acceptance of cruelty to animals.

Children's Beliefs about Pet Minds

An adapted version of the Children's Beliefs about Animal Minds measure (Hawkins & Williams, 2016; Menor-Campos, Hawkins & Williams, 2018) was created for the purpose of this evaluation, named Children's Beliefs about Pet Minds. Each scale (e.g., "Do you think the following animals are ...?") relates to a specific sentence item (clever/pain/happiness/sadness/fear). These questions were asked in relation to dogs, cats and rabbits. Each item is scored on a 5-point Likert scale ("Strongly disagree" to "Strongly agree"). Total scores were calculated for each species (score range 5-25) as well as an overall Child-BAM score across all species (score range 15-75) where a high score indicates high Child-BAM. The measure demonstrated high reliability within the current sample ($\alpha = 0.91$).

Children's Knowledge about the Five Freedoms for Pets

This knowledge question asked, "What do dogs/cats/rabbits need to be happy and healthy?". An image of each animal was provided with space around the image for children to write freely. Answers were coded according to the five animal freedoms. For example, mentioning food, water and hay for rabbits would score the child three points for 'freedom from thirst, hunger and malnutrition'. Total scores for each species were calculated as well as a total knowledge score across species. The measure demonstrated very good reliability within the current sample ($\alpha = 0.76$). There was no maximum total score.

Children's Knowledge about Appropriate and Safe Behaviour towards Pets

This measure was developed specifically for this study to test elements of the intervention around appropriate and safe behaviour. The measure asked, "Should you do the following...?" for 12 items. Four questions per species were included and the questions were taken directly from those included in the game intervention. One question per species was asked for welfare knowledge (e.g. "Give cats toys such as a scratching post?"), one question per animal for cruelty (e.g. "Shout or scream at a dog?"), one question per species for neglect (e.g. "Leave a cat for a few days without feeding it?") and one question per species for safe behaviour towards animals (e.g. "Touch a rabbit when it is showing its teeth or stomping its feet?"). Total scores for each species were calculated (score range 4-20) as well as a total knowledge score across all species (score range 12-60) where a high score indicated high knowledge. The measure demonstrated very good reliability within the current sample ($\alpha = 0.74$).

Children's Compassion towards Animals

The Children's Compassion towards Animals measure (CCA; Hawkins, Williams & Scottish SPCA, 2017b) was included for this evaluation. This measure uses a one 5-item scale asking "What do you think about animals?" with five statements (e.g., "When I see an animal that is hurt or upset I feel upset" and "When I see an animal that is hurt or upset I want to help it"). The measure was scored on a 5-point Likert scale ("Strongly disagree" to "Strongly agree"). Total scores were calculated (range 5-25). This measure demonstrated good reliability within the current sample ($\alpha = 0.61$).

Children's Acceptance of Cruelty towards Pets (CACP)

A new measure was developed for the purpose of this study named Children's Acceptance of Cruelty to Pets (CACP). This measure included three 9-item scales with the question "Do you think it is alright to..." with nine statements (e.g. "make a cat scared?"). The measure was based on pet sentience (e.g. "make a dog sad?" and "injure a rabbit") and pet welfare needs (e.g. "not give a rabbit food or water?"). The measure comprised of three separate scales, one for each pet species (dogs/cats/rabbits). Each item was scored on a 5-point Likert scale ("Strongly disagree" to "Strongly agree"). Total scores were calculated for each species (score range 9-45) as well as an overall cruelty score across all species (score range 27-135) where high scores indicate high acceptance of animal cruelty. This measure showed high reliability within the current sample ($\alpha = 0.85$).

Analysis

Total scores were added for each key variable for each individual at each sample point and data were analysed at the individual level using the Statistical package for the Social Sciences Statistics 24 (SPSS Inc.), with a two-tailed significance of $p < .05$. Initially the data was checked for outliers, normal distribution, homogeneity of variances and sphericity, and outliers were removed from analysis. A two-way repeated measures ANOVA using time (phase of testing: pre-test, post-test) as the within-subject variable and group (two conditions: test, control) as the between-subject variable, tested main and interaction effects. The focus of the results reported below are the interaction effects which show a difference in performance for the intervention group but not the control. Significant interactions were analysed using simple main effects analysis of time within the treatment condition, this indicated whether there was a significant change from pre-test to post-test in the test group, but not in the control group. Where there was no statistically significant interaction, main effects were reported. ANCOVA was used to examine whether the interaction remained significant once adjusting for pre-test scores, age, gender and pet ownership.

Results

Beliefs about pet minds

Pet Welfare significantly improved total beliefs about pet minds scores; there was a statistically significant interaction between the intervention condition and time (Table 1, 2). The intervention group significantly improved at post-test whereas the control group did not. The difference between game intervention and control at post-test remained significant when adjusting for pre-test scores and demographics using ANCOVA (Table 3). A significant effect of the intervention was also found in the scores given to each species' minds, these effects remained significant when adjusting for pre-test scores and demographics using ANCOVA (Table 1, 2, 3).

Children's knowledge about the Five Freedoms

Pet Welfare significantly improved total knowledge about the five freedoms scores; there was a statistically significant interaction between the intervention condition and time (Table 1, 2). The intervention group significantly improved at post-test whereas the control group did not. The difference between game intervention and control at post-test remained significant when adjusting for pre-test scores and demographics using ANCOVA (Table 3). A significant effect of the intervention was also found for dog, cat and rabbit welfare knowledge, these effects remained significant when adjusting for pre-test scores and demographics using ANCOVA (Table 1, 2, 3).

298

299 **Knowledge about Appropriate and Safe Behaviour towards Pets**

300 Pet Welfare significantly improved total knowledge about appropriate and safe behaviour towards
301 pets scores. There was a statistically significant interaction between the intervention condition and
302 time (Table 1, 2). The intervention group significantly improved at post-test whereas the control
303 group did not. The difference between game intervention and control at post-test remained significant
304 when adjusting for pre-test scores and demographics using ANCOVA (Table 3). A significant effect
305 of the intervention was also found for dog and rabbit behaviour knowledge. These effects remained
306 significant when adjusting for pre-test scores and demographics using ANCOVA (Table 1, 2, 3). No
307 significant effect of the intervention was found for knowledge about appropriate and safe behaviour
308 towards cats, although a significant difference was found after adjusting for pre-test scores and
309 demographics using ANCOVA (Table 1, 2).

310

311 **Compassion towards Animals**

312 Pet Welfare did not significantly improve children's scores for compassion towards animals. No
313 statistically significant interaction between the intervention condition and time was found (Table 1, 4).
314 This result remained nonsignificant when adjusting for pre-test scores and demographics using
315 ANCOVA (Table 2).

316

317 **Children's acceptance of cruelty to pets**

318 Pet Welfare did not significantly improve scores for total attitudes towards cruelty to pets, no
319 statistically significant interaction between the intervention condition and time was found (Table 1, 4).
320 However, a significant difference was found when adjusting for pre-test scores and demographics
321 using ANCOVA (Table 2). No significant effect of Pet Welfare was found for cruelty to dogs or cats,
322 these results remained nonsignificant when adjusting for pre-test scores and demographics using
323 ANCOVA (Table 1, 2, 4). There was a significant effect of Pet Welfare for cruelty to rabbits, this
324 remained significant when adjusting for pre-test scores and demographics using ANCOVA (Table 1,
325 2,).

326

327 [Tables 1-4 about here]

328

329

Discussion

330

331 The purpose of this study was to evaluate a novel animal welfare ‘serious game’ named Pet Welfare.
332 The game was designed to impact the cognitive and affective dimensions of child-animal interactions,
333 with the overarching goal of preventing unintentional animal cruelty and neglect and to promote
334 positive child-pet interactions. The aim was to modernise and maximise the learning and teaching of
335 animal welfare education by utilising technology, thereby making animal welfare education more
336 interactive and engaging. A key question was whether the Pet Welfare game intervention would have
337 a significant impact on children’s beliefs about pet minds, knowledge about animal welfare needs,
338 knowledge about appropriate and safe behaviour towards pets, compassion towards animals and
339 acceptance of cruelty towards pets.

340 Firstly, it was promising that despite relatively high pre-test scores (average score 65.2 out of 75, 58%
341 scored above the mean), Pet Welfare was successful at increasing children’s beliefs about pet minds.
342 Total scores as well as scores for each animal, increased at post-test. These findings suggest that
343 teaching children about pet sentience will increase their understanding of animal minds.
344 Anthropomorphic attributions of emotions and cognition to other species, or holding a belief that
345 animals are sentient, is arguably at the core of human-animal relationships (Urquiza-haas &
346 Kotrschal, 2015). Such abilities facilitate social interactions, social bonds, but are also prerequisites
347 for empathy development and moral concern (Baron-Cohen, Tager-Flusberg & Lombardo, 2013;
348 Eisenberg, Huerta & Edwards, 2012). Believing that animals cannot feel emotions and lack sentience
349 (low beliefs about animal minds) is related to negative child-animal interactions (low compassion,
350 low humane behaviour, negative attitudes and higher acceptance of animal cruelty; Hawkins &
351 Williams, 2016) as well as aggressive beliefs and behaviour (Randour & Gupta, 2013; Sprinkle,
352 2008).

353 In recent years, there has been a movement towards focusing on positive welfare (increasing well-
354 being)., This movement involves education about increasing animal’s happiness such as opportunities
355 for enrichment and positive social interactions (Mellor & Beausoleil, 2015). In Pet Welfare
356 information was provided about what children can do to make their animals ‘happy and healthy’ in
357 line with animal welfare needs (The Animal Welfare Act, 2006; Animal Health and Welfare
358 (Scotland) Act, 2006). Pet Welfare was successful at increasing children’s knowledge about animal
359 welfare needs, this included total scores as well as scores for each pet type. These results are
360 promising when considering that teaching children how to interpret animal welfare needs will
361 facilitate positive child-animal interactions such as caring behaviour, and lead to better care (Muldoon
362 et al., 2009). Such caring behaviour may also foster a child-pet attachment which, as known from
363 previous studies, has developmental benefits (Muldoon, Williams & Lawrence, 2016, Hawkins,
364 Williams & Scottish SPCA, 2017b).

Pet Welfare aimed to encourage children to think about an animal's perspective and encourage children to behave in ways that will not be harmful to an animal. Although evidence is limited, recent findings demonstrate the potential of education at promoting such beliefs and knowledge (Angantyr et al., 2016; Coleman, Hall & Hay, 2008; Fonseca et al., 2011). In line with these previous findings, it was promising that Pet Welfare was successful in increasing children's knowledge about appropriate and safe behaviour towards pets. Children improved on total scores and for each pet type. Given the range of positive psychological, emotional and physiological health outcomes of pets for children (Purewal et al., 2017), facilitating positive and safe child-pet interactions has important implications that are often overlooked in research. Increasing such knowledge, as demonstrated through Pet Welfare, is also important for preventing injuries to children, as well as preventing distress to pets (Shen et al., 2016), yet children lack this knowledge. One consequence of children's lack of understanding, is dog bites which remains a public health problem. With better knowledge, perhaps children would learn better ways to interact with dogs, reducing the likelihood of being bitten (Lakestani & Donaldson, 2015; Westgarth, Brooke & Christley, 2018). Future studies may wish to include other common 'high-risk' situations such as safe child-dog interactions (Dixon, Mahabee-Gittens, Hart & Lindsell, 2012) including touching or removing a food bowl when a dog is eating as resource guarding is a common cause of dog bites (Reisner, Shofer & Nance, 2007). Also, safe handling of animals may be important for preventing accidental injury to pets and injuries to children (Dickman, 2013). This study supports previous research that found knowledge is the most susceptible to change through intervention (Reisner, Shofer & Nance, 2007; Mariti et al., 2011; Vermeulen & Odendaal, 1993).

A key aim of animal welfare education is to prevent violence towards animals, and it was anticipated that Pet Welfare would decrease children's acceptance of cruelty. However, a significant reduction was found only for rabbits, a common target of cruelty and neglect. A lack of change overall may be due to the measure itself, low acceptance of cruelty at baseline, or that the intervention did not have a strong focus on animal cruelty. It is important to prevent childhood cruelty to animals given the complex relationship between animal-directed and human-directed violence, low cognitive empathy, behavioural problems and that cruelty attitudes and behaviour are related (Monsalve, Ferreira & Garcia, 2017; Trentham, Hensley & Policastro, 2017; Hartman et al., 2016; Hawkins et al., 2017). Further research is therefore required to examine how to successfully address animal cruelty in childhood education, and address how attitudes towards animal cruelty, translate to long-term behaviour. It was positive though that children in our study were generally unaccepting of cruelty at baseline (scoring an average of 31.2 out of 135, where a high score indicates high acceptance). This was especially true for dogs, and items relating to intentional cruelty. Future educational programmes should be aimed at those children 'at risk' for violence.

Another key aim of animal welfare education is to promote compassion and kindness towards animals. However, Pet Welfare was not successful at increasing children's self-reported compassion towards animals. This suggests that it may not be possible to intervene at the affective level through a short classroom-based digital educational intervention. Pet Welfare was designed to prevent unmotivated, or accidental animal cruelty and neglect, and so it may not be effective for children who lack compassion and empathy (Decety et al., 2016). Children in the current study also demonstrated high compassion at baseline (average score of 20.8 out of 25), leaving little room for improvement. It could be the measure used, or it could be argued that no change was observed due to Pet Welfare being a one-off, short intervention. However, no impact on compassion was found in a longer-term (6 week) follow-up of a short intervention (Hawkins, Williams & Scottish SPCA, 2017a). It may be that compassion is resistant to change through interventions that do not include direct contact with animals, given that caring behaviour towards pets promotes attachment and compassion (Hawkins, Williams & Scottish SPCA, 2017b). However, we cannot make conclusions about this given the lack of evidence. Previous research has shown that direct contact with animals is important for developing compassion, moral concern, species-specific knowledge of animal care, understanding of appropriate about pet care and needs, and promoting human-animal bonds (Melson, 2003; Kurdek, 2008; Serpell, 2004; Yoyama, Lee & Muto, 1997). However, involving animals in education raises welfare concerns and the impact on the animals themselves who are involved in animal welfare education is very much an under researched (Fine & Huss, 2017). There is no legislation in the UK to enforce these types of activities. The question of whether the affective domains of child-animal interactions can be promoted through humane educational remains.

Kellert (1985) recommended focusing educational efforts for 6-10-year-olds on children's affective reactions to animals and building on children's positive orientations to animals. This is due to this age range being characterised by a major increase in emotional concern and affection for animals. A dramatic improvement in factual and cognitive understanding of biology and animals is seen between 7-14 years (Binnie & Williams, 2002; Myant & Williams, 2005). As Pet Welfare was aimed at children aged 7-12-years old, both affective and cognitive domains were targeted, and potential age differences were considered, as recommended by Arbour, Signal and Taylor (2009). Middle childhood is an important time for educational intervention due to a peak in pet ownership (Paul & Serpell, 1993), receptivity to animal welfare education (Melson, 2003), as well as important changes in cognitive development including increases in prosocial moral reasoning and empathetic moral concerns (Eisenberg-Berg, 1979; Flavell, 2004). Furthermore, childhood is a key time for the development of attitudes and related behaviours, reinforcing the importance of encouraging humane orientations to animals early on (Borgi & Cirulli, 2015).

Although this study displays promising findings, longer-term evaluation is required with a larger population to test the reliability of findings and suitability of the intervention for other cultural

contexts. This research was conducted within three primary schools within West Lothian in Scotland and so the results should be generalised with caution. Conclusions can only be drawn about the short-term effects of the programme and it is not known how knowledge gained through this programme will generalise to other animals and translate long term. However, feedback from the children was extremely positive (scoring an average of 4.5/5), and the children reported that they wanted more animals and more levels to play. It is recommended that a longer, more complex game with more animal types and varied levels is developed.

Conclusion

This study highlights the potential of promoting positive child-animal interactions and preventing accidental animal cruelty and neglect through the use of a fun, reward-based, interactive child-friendly digital game. This study is the first evaluation of an animal welfare education computer game for children and the results are promising with the game having a significant impact on knowledge, attitudes and belief in animal minds. Future work in this area may include the development of more varied and complex games, and different methods of delivering games. Through education, children learn kindness, and how to become responsible animal citizens in their communities, which will in turn have wider, long-term implications for a humane society and the prevention of violence.

Acknowledgements

We thank the schools, teachers and children who were involved for their invaluable time and collaboration.

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Table 1*Descriptive statistics.*

	Test				Control			
	Pre-test		Post-test		Pre-test		Post-test	
	M	SD	M	SD	M	SD	M	SD
Beliefs about pet minds								
Total beliefs about pet minds	65.56	8	72.31	7	64.77	10	66.28	11
Dog minds	22.27	2.9	24.37	1.8	21.83	3	22.65	3
Cat minds	21.78	3	24.04	2.7	21.43	4	21.98	4
Rabbit minds	21.53	3	23.87	3	21.42	4	21.49	4
Knowledge about animal welfare needs								
Total knowledge	24.03	8.5	25.55	10	19.04	6.7	17.23	7.9
Dog welfare	8.33	3	8.6	3.6	6.86	2.7	5.84	2.7
Cat welfare	7.32	2.8	8.16	3.4	5.85	2.5	5.56	2.8
Rabbit welfare	8.26	3.3	8.6	3.6	6.37	2.4	5.84	2.7
Knowledge about appropriate and safe behaviour towards pets								
Total knowledge	55.77	3	59.01	1.9	56	5.5	56.57	3.3
Dog knowledge	18.68	1.3	19.70	.81	18.71	2	18.81	1.3
Cat knowledge	18.99	1.4	19.80	.74	18.95	2	19.25	1.4
Rabbit knowledge	18.10	1.6	19.51	1.1	18.34	2.2	18.95	2
Compassion towards animals								
Total compassion	20.48	2.4	20.99	2.4	21.04	3.2	21.58	2.9
Acceptance of cruelty to pets								
Total acceptance of cruelty to pets	31.57	6.6	28.41	3.3	30.92	8.3	29.99	6
Cruelty to dogs	10.42	2.3	9.58	1.3	10.53	4	9.93	2
Cruelty to cats	10.68	3.3	9.46	1.3	10.22	3	9.91	2
Cruelty to rabbits	10.70	2.97	9.47	1.3	10.21	2.4	10.15	2.2

Table 2

	Interaction effects from two-way repeated measures ANOVA	Controlling for demographics and baseline scores using ANCOVA
Beliefs about pet minds		
Total beliefs	F(1,166)=27.6, p=.0001, η^2 =.14	F(1,168)=33.84, p=.0001, η^2 =.17
Dog minds	F(1,170)=15.05, p=.0001, η^2 =.08	F(1,172)=24.8, p=.0001, η^2 =.13
Cat minds	F(1,168)=18.43, p=.0001, η^2 =.10	F(1,170)=22.5, p=.0001, η^2 =.12
Rabbit minds	F(1,168)=26.5, p=.0001, η^2 =.14	F(1,170)=31.2, p=.0001, η^2 =.16
Knowledge about welfare needs		
Total knowledge	F(1,167)=15.2, p=.0001, η^2 =.084	F(1,169)=23, p=.0001, η^2 =.123
Dog welfare	F(1,169)=15.2, p=.0001, η^2 =.08	F(1,171)=25.4, p=.0001, η^2 =.13
Cat welfare	F(1,167)=11.8, p=.001, η^2 =.07	F(1,169)=24, p=.0001, η^2 =.13
Rabbit welfare	F(1,169)=7.72, p=.006, η^2 =.044	F(1,171)=18.5, p=.0001, η^2 =.1
Knowledge about appropriate and safe behaviour towards pets		
Total knowledge	F(1,165)=12.7, p=.0001, η^2 =.072	F(1,167)=36.3, p=.0001, η^2 =.18
Dog knowledge	F(1,165)=11.06, p=.001, η^2 =.06	F(1,167)=28.2, p=.0001, η^2 =.15
Cat knowledge	F(1,166)=3.9, p=.05, η^2 =.023	F(1,168)=11.6, p=.001, η^2 =.07
Rabbit knowledge	F(1,165)=11.06, p=.001, η^2 =.06	F(1,167)=22.4, p=.0001, η^2 =.12
Compassion towards animals		
Total compassion	F(1,171)=.09, p=.77, η^2 =.001	F(1,173)=2.2, p=.14, η^2 =.013
Acceptance of cruelty to pets		
Total acceptance of cruelty to pets	F(1,166)=3.12, p=.079, η^2 =.02	F(1,168)=33.84, p=.0001, η^2 =.17
Cruelty to dogs	F(1,169)=.09, p=.077, η^2 =.001	F(1,171)=1.21, p=.27, η^2 =.01
Cruelty to cats	F(1,168)=1.9, p=.174, η^2 =.011	F(1,170)=2.1, p=.058, η^2 =.022
Cruelty to rabbits	F(1,167)=8.8, p=.004, η^2 =.05	F(1,169)=9.5, p=.002, η^2 =.001

Table 3
Results for main simple effects following significant interactions.

Test x Control at Pre-test				Test x Control at Post-test			
df	F	p	η^2	df	F	p	η^2
Beliefs about pet minds							
Total beliefs about pet minds							
1,180	.331	.57	.002	1,171	20.2	.0001	.11
Dog minds							
1,182	.893	.346	.005	1,173	18.2	.0001	.096
Cat minds							
1,182	.52	.472	.003	1,172	16.6	.0001	.09
Rabbit minds							
1,182	.042	.837	.0001	1,172	20.1	.0001	.11
Knowledge about animal welfare needs							
Total knowledge about animal welfare needs							
1,181	19.2	.0001	.097	1,170	35.7	.0001	.18
Dog welfare							
1,181	11.8	.001	.061	1,172	32.2	.0001	.16
Cat welfare							
1,181	13.9	.0001	.072	1,170	29.6	.0001	.15
Rabbit welfare							
1,183	20.2	.0001	.1	1,172	32.2	.0001	.16
Knowledge about appropriate and safe behaviour towards pets							
Total knowledge about appropriate and safe behaviour							
1,181	.12	.73	.001	1,167	36.04	.0001	.18
Dog knowledge							
1,181	.021	.89	.0001	1,167	28.9	.0001	.15
Rabbit knowledge							
1,181	.691	.407	.004	1,167	20.1	.0001	.11

Table 4.

Results from main effects analysis for each intervention following insignificant interactions.

Main effect of time				Main effect of group			
df	F	p	η^2	df	F	p	η^2

Compassion towards animals							
1,171	9.99	.002	.06	1,171	2.7	.15	.012
Total attitudes towards cruelty to pets							
1,166	16.32	.0001	.09	1,166	.322	.57	.002
Attitudes towards cruelty to dogs							
1,169	11.31	.001	.063	1,169	.632	.428	.004
Attitudes towards cruelty to cats							
1,168	13.61	.0001	.08	1,168	.015	.904	.000
Knowledge about appropriate and safe behaviour towards cats							
1,166	13.1	.0001	.073	1,166	2.2	.145	.013

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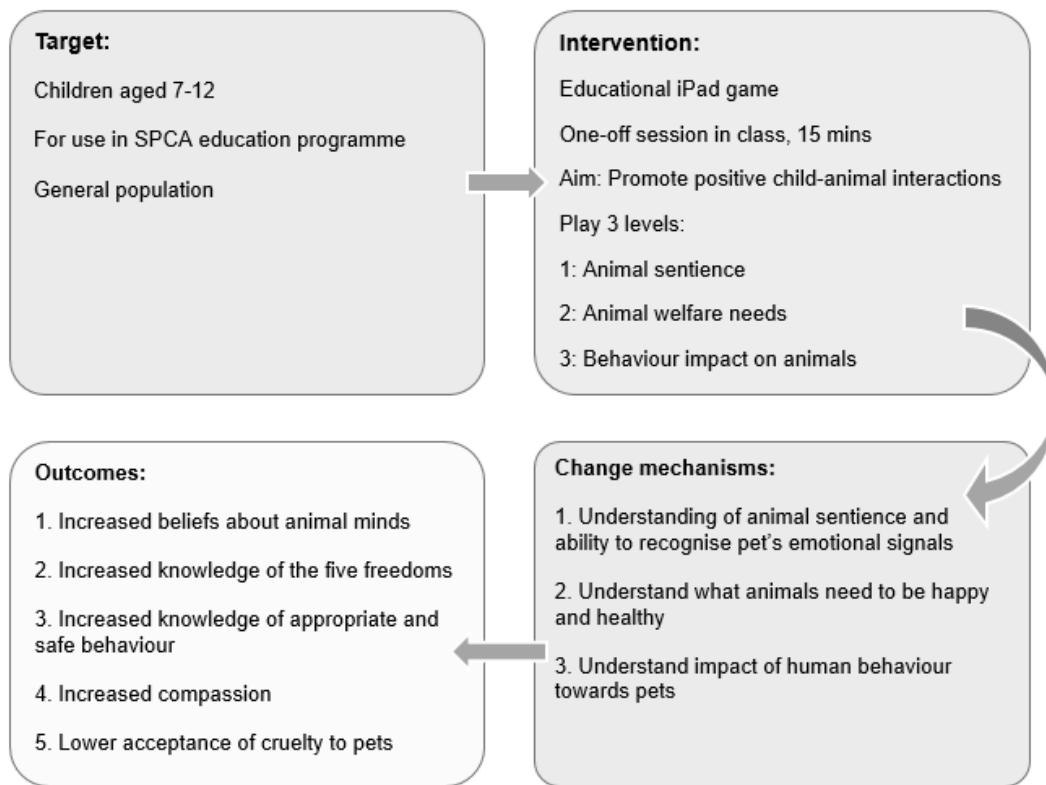


Figure 1. Logic model for Pet Welfare.